Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

WATER-BORNE TYPHOID FEVER OUTBREAK IN TONAWANDA, N. Y.[1]

By THEODORE HORTON, Chief Engineer, New York State Department of Health.

The following report is an account of a disastrous water-borne outbreak of typhoid fever, due to a break in the intake pipe of the water-supply system and the failure of the community to adequately safeguard its water supply. The outbreak was checked by the proper operation of a chlorination plant, in spite of the fact that water grossly polluted with sewage continued to be used.

The history of the outbreak may be briefly summarized as follows: In Tonawanda, N. Y., and near-by towns, there occurred some 236 cases of typhoid fever, having onsets between July 5 and October 4, 1919. Of these cases, 202 were residents of Tonawanda, while the remaining 34 cases were residents of neighboring municipalities where source of infection was attributed to Tonawanda. No information as to any undue prevalence of typhoid fever was received by the State Department of Health until August 7, when the alleged occurrence of many cases of typhoid in Tonawanda was brought to the attention of a representative of the Division of Sanitary Engineering. Immediately an investigation of the water supply situation was started by the division. An engineer visited Tonawanda on August 8, and on August 11 an epidemiological investigation was started by Dr. Senftner. The information secured by these investigations pointed to an infection of the public water supply as the primary source of the outbreak.

The public water supply of Tonawanda is pumped from the Niagara River, the intake being located about 1,800 feet from the American shore, in about 30 feet of water. For years this supply has been used without any purification whatsoever, although numerous recommendations by the Department of Health from time to time have urgently advised the installation of some form of water treatment. The intake has been located at a point well out in the river, where the water is ordinarily less grossly polluted from the sewage discharged into the river above Tonawanda than is that nearer the American shore. The typhoid rate, however, in Tonawanda has always been rather high, although there is no record of any epidemic reaching the proportions of the one here discussed.

It appears that as a result of orders issued by the Federal Government, the city was required to lower its intake line in order to permit the dredging of a deeper ship channel. During the spring of 1919 the city began the construction of a new 48-inch wooden stave intake line laid at the required depth. During the construction of this new intake line it was necessary to cross and break through the old intake pipe at a point some 350 feet or more nearer the American shore, and consequently at a point where the water is more grossly polluted with sewage. This break in the intake line occurred some time between June 19 and July 4, 1919, the exact date not being known. Following the break many cases of severe intestinal disturbances appeared in the city, and later, a few cases of typhoid fever. Advertisements were printed in the public press on July 8 advising the public to boil the water used for drinking purposes. At the same time printed bulletins warning everyone of the danger of drinking the supply without boiling were distributed from house to house.

---

[1] The epidemiological data relative to this outbreak were obtained by Dr. Senftner, Epidemiologist of the Department of Health of the State of New York, and the data relative to the water supply situation were furnished by Assistant Engineers E. S. Chase and Earl Devendorf.

The account of a similar outbreak in Herkimer, N. Y., brought about by the pumping of unchlorinated infected creek water into the city mains was published in Public Health Reports for March 28, 1919, pp. 597-604.

On July 19, 1919, a letter was received from the secretary of the Chamber of Commerce of Tonawanda, advising the Department of Health of the breaking of the intake line, and requesting analyses of the water supply. This communication was answered at once, authorizing the collection of the samples, and calling particular attention to the fact that the matter of purification of the supply had already been repeatedly taken up with the city authorities, even as recently as June 17, 1919. Although no mention was made in the Chamber of Commerce letter of any prevalence of typhoid fever in the city, the seriousness of the situation was pointed out in the reply and, in view of the failure of the local authorities to carry out our recommendations, it was suggested that the Chamber of Commerce use its influence to secure the immediate sterilization of the supply.

The first definite information received by the Department of Health as to any undue prevalence of typhoid in the city was on August 7. As soon as this information as to the occurrence of typhoid fever cases was received the department's emergency chlorination apparatus was shipped at once and was followed by an engineer from the department. Upon the engineer's arrival in Tonawanda it was learned that the city had ordered apparatus for sterilization of the supply with liquid chlorine and that the apparatus had already been shipped from New York by express.

The installation of the city's chlorination apparatus was made on August 11, and sterilization of the supply was started at 4 p. m. on that date and has been continued since that time. This apparatus consists of two Wallace and Tiernan manual-control solution-feed chlorinators installed in the suction well, and the chlorine solution is applied to the raw water in the well before its entrance to the suction lines of the pumps.

On August 23 the use of the old suction line was discontinued and pumping was started through the new intake line. At this time the intake well was by-passed in order to install a new valve and connections and to permit the laying of a new bottom in the well. This work was completed and the use of the by-pass discontinued on September 15. Chlorination, however, was continued during this period by means of a connection from the chlorinators to the by-pass line.

Between September 15 and October 3 the superintendent of water works suspected, from the appearance of the water as pumped, that something was wrong with the new intake line, and on October 3 a diver in the service of the contractors on the new pipe line was employed to examine the line for leaks. On the 4th of October a leak in the line was discovered at a point very near the American shore. This leak was found at a point where the pipe was about 4 inches off center, thus leaving a large opening for water near the shore to enter the line. The leak was repaired by placing a sleeve around the joint, making it water-tight. On October 9 the diver discovered a second break about 300 feet from the intake pier, where one end of a section of pipe was in such bad condition that it had to be replaced. The replacement of this section of pipe was completed on October 14. So far as known this was the last date on which any work was done on the intake line, and it is assumed that no serious leaks have occurred since that time. The trench in which the line is laid was backfilled to a depth of about 4 feet. During the period between September 15 and October 4, when leaks occurred and were being repaired, water of a very objectionable character was alleged to have been pumped into the distribution mains. In fact, it was stated that even particles of garbage and offal were removed from the pumps and suction well at the pumping station during the latter part of September, indicating clearly the grossly polluted character of the water being pumped at that time.

The chlorination plant from the time of its installation has been under constant oversight, and its operation has been uninterrupted. Scales were provided to check the readings of the manometer, and starch iodide tests were made every day to determine an excess of chlorine in the treated supply, the intention being to maintain a slight excess at all times. Chlorine was applied to the water at the rate of 5 pounds per million gallons at the beginning, but this rate was later cut to 3.5 pounds per million gallons, and still later increased to 4 pounds. Engineers from the Division of Sanitary Engineering visited the pumping station on September 18, October 10, October 20, November 1, and November 20, and each time it was found that the chlorination plant was being properly and carefully operated. A table giving the results of the analyses of samples of the supply made from time to time by the Division of Laboratories and Research is printed on page 399. From this table the grossly contaminated condition of the raw water is shown by the high total counts and the prevalence of organisms of the *B. coli* type. In the case of the samples of chlorinated water the total bacterial counts are low, except where the samples were delayed in transit, and in all samples of the treated supply no *B. coli* were isolated from any of the inoculations examined. These results indicate that the chlorination had been effective in removing contamination.

The epidemiological data relative to 202 of the cases occurring in the city of Tonawanda were obtained by a house to house canvass made by Dr. Senftner. From the compilation of the information secured by Dr. Senftner a chart of onset dates has been made (Fig. 1). From this chart it will be seen that the majority of onsets occurred between July 4 and September 15, the cases beginning almost immediately after the break in the old intake line and continuing for about four weeks after the installation of the chlorination plant. It will thus be seen that, allowing for an extreme incubation period of four weeks, the installation and operation of the chlorination plant brought about an almost immediate checking of the outbreak in spite of the fact that water grossly polluted with sewage was taken through leaks in the new intake line between August 23 and October 14. Considering the character of the raw water during this period, it is noteworthy that chlorination alone was effective in checking the spread of the infection through the water supply. Since October, 1919, (to January 1, 1920, the date of this report) but five cases have been reported from Tonawanda.

In addition to the public-water supply, about 40 local wells scattered throughout the city have been used by the public. Of these there is record of only one, the Johnson well, on North Niagara Street, having been used by a considerable number of typhoid cases. Some 25 cases, however, gave evidence of having used water from this well, but as they also used the city water unboiled it is not possible to state definitely whether this well was infected or not at that time. The well is very poorly located with respect to underground pollution, and is so poorly protected at the surface that it might easily have become infected, and the analysis of a sample from it indicates the presence of active contamination. It is very possible, therefore, that, notwithstanding that cases who drank of the well also drank of the public-water supply, this well had become infected and was responsible for some share of the 25 cases who drank water from it. As a matter of precaution this well was closed and the pump removed on September 5.

Another indeterminate matter in connection with the outbreak affecting, however, only a few cases, is that with reference to some 15 cases which occurred among employees of the Tonawanda Board & Paper Co. Upon investigation it was found that an industrial water supply derived from the Niagara River was readily accessible to the employees and that all 15 cases had drunk this industrial water from a hose. These cases, however, also drank from the city supply, but the company did not start operations until about the 15th of August, at which time the city supply was being chlorinated. Furthermore, it is stated that many of the employees drank water from the Johnson well mentioned above. It is obviously impracticable, therefore, to determine as to what extent these cases were attributable to the three possible sources of infection.

Although the great majority of cases gave evidence of having used unboiled city water, and while the analyses, with respect to breaks in the intake lines, indicate clearly that the city water was the principal source of the infection, yet, to warrant the exclusion of milk as a possible source of the infection, the case data collected by Dr. Senftner with respect to the sources of milk supply have been summarized as follows:

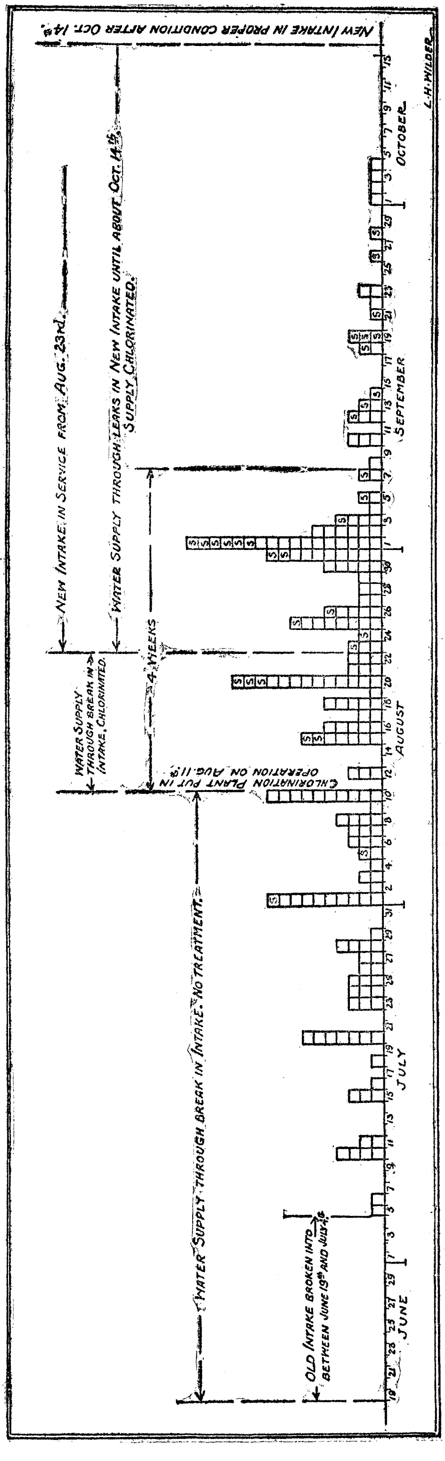

FIGURE 1.—Number of cases, by dates of onset, of typhoid fever at Tonawanda, N. Y., 1919. Each square represents 1 case; S represents a secondary or possible contact case.

TABLE 1.

Milk dealers.	Milk supply.		Typhoid cases.	
	Gallons of milk delivered.	Per cent.	Cases on route.	Per cent.
Twin City Dairy Products Co	1,044	78	80	50
Matthies Bros	115	9	20	12
Eckstein	98	7	36	22
Geisler	60	4	18	11
Hollister	25	2	8	5
Total, principal dealers	1,342	100	162	100
6 miscellaneous dealers			15	
Condensed and evaporated milk			12	
Own or neighbor's cow			11	
None or unknown			2	

From this table it will be seen that there was no undue excess of cases upon the route of any one dealer.

With respect to age distribution the following summary has been made:

TABLE 2.

Age.	Cases.	Per cent.
0 to 10	34	17
10 to 20	79	39
20 to 30	37	18
30 to 40	27	13
40 to 50	13	7
50 to 70	12	6
Total	202	100

This age distribution is typical of that usually found in waterborne typhoid fever outbreaks.

An investigation of the other possible sources of infection, such as soda, ice cream, butter, and ice, indicates that none of these supplies was used in common by any considerable number of cases. Nor was there any undue association or common occupation except in the case of the employees of the Tonawanda Board and Paper Co. The cases were also scattered fairly uniformly over the city.

Of the 202 cases in Tonawanda which were investigated, some 32 were secondary, and of the 22 cases outside of Tonawanda, 4 were secondary in origin. In Tonawanda, 11 cases, and outside of Tonawanda 7 cases terminated fatally, making a total of 18 deaths among 236 cases, or a fatality rate of 1 death per 13 cases.

The work carried on to check the spread of the disease, in addition to the chlorination of the public water supply, consisted of the immunization of contacts, the typhoid fever vaccine being furnished by the Division of Laboratories and Research of the Department of Health, and the visits to homes in which cases occurred, by Red Cross and city nurses assigned for the purpose, who gave instructions and distributed typhoid fever circulars of the Department of Health.

It is of interest to note that the water supply of Tonawanda has been repeatedly investigated by the Health Department, and recommendations for its purification have been made. In 1912 a report upon the supply recommended its immediate purification or the introduction of a new and satisfactory supply. In 1916 a report on a reinspection of the supply recommended filtration and sterilization and the immediate installation of duplicate chlorination apparatus. In 1918 Mr. H. B. Cleveland, principal assistant engineer, appeared before the common council and the board of health and again urged the installation of a chlorination apparatus. Later, a letter to the superintendent of waterworks gave the names of manufacturers of chlorination apparatus and gave certain general advice relating to chlorination.

During the present year several additional letters urging chlorination have been sent to the city authorities. A letter dated January 25, 1919, to the mayor, relative to the water supply situation in Tonawanda, again strongly urged chlorination of the supply and requested information as to what action had been taken by the city toward the carrying out of our recommendations. No reply was received to this letter. Another letter dated April 4, 1919, addressed to the mayor, referred to the previous letter of January 25 and requested a reply, but no answer was received to this letter. Another letter was sent on June 5, 1919, referring to previous letters and again asking for information relative to chlorination. A reply was received from the city clerk under date of June 18 to the effect that no action had been taken toward installing chlorination. On June 17 a letter was sent to the superintendent of waterworks, inquiring as to what action had been taken in the matter and a reply was received from him under date of June 19 to the effect that no action had been taken. In a letter dated July 19 to the secretary of the Chamber of Commerce it was suggested that they urge upon the city authorities the chlorination of the supply. A report upon the water supply dated August 5 again recommended filtration and immediate chlorination. These letters of advice and report were all transmitted before information had been received by the Department of Health of the typhoid fever outbreak in the city of Tonawanda.

Not until this outbreak of typhoid fever occurred did the city take any active steps toward carrying out our recommendations relative to purification of the supply. The chlorination plant was not ordered until August 6, even though the break in the intake was known to have occurred prior to July 4 and the efficacy of chlorination and the need for it had been repeatedly pointed out by this department. We have been recently advised that the people have voted favorably upon the installation of a filter plant. While this is a commendable step in view of the misfortune that has befallen the city, and while the chlorination plant since its installation has been operated with commendable efficiency, it is greatly to be regretted that a typhoid outbreak of serious proportion, with the suffering, toll of death, and economic loss that such an outbreak involves, was necessary to bring about the measures finally adopted for the protection of the water supply.

From the evidence presented in this report and in the appended tables, it may be concluded—

(1) That the outbreak of typhoid in Tonawanda, herein described, was due to an intensive infection of the public water supply, following the breaking of the intake line at a point in the river considerably nearer the American shore than the intake crib.

(2) That, had a chlorination plant been installed and in proper operation prior to this outbreak, as had been repeatedly recommended by the State department of health, the outbreak would not have occurred.

(3) That the installation of a chlorination plant resulted in an almost immediate checking of the outbreak, and undoubtedly prevented a much more severe outbreak from subsequent leaks in the new intake line when this line was first put into service.

(4) That, since its installation, the chlorination plant has been operated with care and efficiency.

(5) That most, if not all, of the local wells in the city of Tonawanda undoubtedly receive gross pollution; and in the case of the Johnson well, it is probable that actual infection occurred.

(6) That at certain mills the accessibility of polluted industrial water supplies, and their consequent use for drinking purposes, either through ignorance or carelessness, give opportunity for infection of employees.

(7) That while chlorination, if properly supervised, will greatly minimize the danger of infection from the public water supply, it will not improve the physical quality of the supply; and, in the case of the Tonawanda supply, which is at times decidedly turbid, filtration is necessary to produce a supply of a satisfactory physical quality at all times.

In view of the above conclusions, it is recommended—

(1) That the city authorities continue constantly a careful and efficient operation of the chlorination plant.

(2) That the city install at the earliest possible time a modern filtration plant, supplemented by some method of sterilization, for the treatment of the water supply.

(3) That the use of all local wells in the city be abandoned.

(4) That all industries using auxiliary supplies subject to contamination, either purify these supplies or use them only for fire

service or industrial purposes in such a manner as to render them inaccessible for drinking purposes.

(5) That all such systems of industrial supplies subject to pollution, used for fire service or industrial purposes, be entirely severed from the public water supply system of the city or be connected with it only through satisfactorily installed systems of double check valves.

TABLE 3.—*Results of water analyses.*

Source of sample.	Date of collection.	Bacteriological.			
		Bacteria per cc. gelatin 20° 48 hours.	B. Coli type, += Present, —= Absent.		
			10 cc.	1 cc.	$\frac{1}{10}$ cc.
Tap, pump station	June 12, 1919	[a]3,300	3+, 0—	3+, 0—	1+, 2—
Tap, Fries' Drug Store	July 21, 1919	8,000	3+, 0—	3+, 0—	1+, 2—
Tap, Burtch's Drug Store	do	3,000	3+, 0—	3+, 0—	3+, 0—
Tap, pump station	do	4,200	0+, 3—	0+, 3—	0+, 3—
Tap, city hall	Aug. 8, 1919[1]	[a]16,500, P	3+, 0=, P	3+, 0=, P	3+, 0—
Raw water intake	Aug. 29, 1919	[b]150,000	3+, 0—	0+, 3—	0+, 3—
Chlorinated water, pump station	do	[b]400,000	0+, 3—	0+, 3—	0+, 3—
Do	Sept. 18, 1919	112,000	0+, 3—	0+, 3—	0+, 3—
Raw water, intake well	Oct. 10, 1919	280,000	3+, 0—	3+, 0—	3+, 0—
Chlorinated water, 44 p. p. m	do	0	0+, 3—	0+, 3—	0+, 3—
Chlorinated water, 48 p. p. m	do	4	0+, 3—	0+, 3—	0+, 3—
Chlorinated water, city hall	do	350	0+, 3—	0+, 3—	0+, 3—
Raw water, suction well	Oct. 13, 1919	[b]1,900	3+, 0—	3+, 0—	1+, 2—
Chlorinated water, pump station	do	[b]35	0+, 3—	0+, 3—	0+, 3—
Niagara River, intake pier	do	[b]37,000	3+, 0—	3+, 0—	1+, 2—
Raw water, intake well	Nov. 1, 1919	[c]51,000	3+, 0—	3+, 0—	1+, 2—
Chlorinated water, pump station	do	[c]7	0+, 3—	0+, 3—	0+, 3—
Raw water, intake well	Nov. 20, 1919	[a]21,000	2+, 1—	0+, 3—	0+, 3—
Chlorinated water, pump station	do	[a]1	0+, 3—	0+, 3—	0+, 3—
Johnson well	Sept. 18, 1919	1,100	3+, 0—	3+, 0—	0+, 3—

[1] Chlorination plant installed Aug. 11, 1919.
P=Presumptive test for *B. coli.*
[a] 4 days in transit.
[b] 3 days in transit.
[c] 2 days in transit.

CLEANSING THE SKIN IN VACCINATIONS.

A CAUTION AGAINST THE USE OF ALCOHOL CONTAINING PHENOL.

It has come to the attention of the Public Health Service that denatured ethyl alcohol containing phenol has been used for the purpose of cleansing the skin at the site of vaccination against smallpox. The Bureau believes that such procedure would materially decrease the likelihood of securing successful "takes" from vaccine, and suggests that cleansing the skin with soap and water is preferable, but if another agent is desired ether may be used.